Improving the EWA Implementation Process:
Science Program and EWA Agencies' Progress in Water Year 2005

Erin Chappell (DWR)
Victoria Poage (USFWS), Alice Low (DFG), Randall Brown (CBDA),
Bruce Oppenheim (NOAA Fisheries)

The EWA Technical Review Panel (Panel) prepared a report for the Lead Scientist in January 2005 following the November 2004 EWA Workshop. In that report the Panel recommended that the EWA agencies needed to expand the research base and upgrade the quality of science underlying EWA program decisions. In the Lead Scientist and EWA agencies joint response to the Panel we outlined a framework to address the important issues identified by the Panel, with the overall goal of increasing the efficacy of the EWA. In this report we address the progress that has been made on each of these issues in 2005.

I. Use and Interpretation of Gaming

Action: Document gaming objectives clearly. Set up technical panel of outside experts on modeling, gaming, ecosystem dynamics, risk assessment, and fish biology. Team this panel with appropriate agency scientists/managers familiar with EWA and the broader water operations system.

Commitments: CALFED science program: Establish and fund technical experts. EWA agencies: Supply staff participation, organization, and logistics.

Progress: No work has been completed on gaming in 2005. It may be addressed in 2006.

II. Interpretation and Use of Models

A. Fish Population Models

Action: The CALFED Science Program PSP called for research supporting development of specific models, including those related to delta smelt and salmon. EWA agencies will continue developing the Delta Smelt Decision Matrix (DSRAM) and supporting the IEP and other researchers attempting to develop population estimates and models for delta smelt and encourage their submission for peer review and external assessment.

Commitments: CALFED Science Program: Fund CALFED Science Programs PSP proposals as approved by the Authority and facilitate workshops on delta smelt models, with emphasis on developing the framework for ecosystem-level models encompassing population effects. EWA agencies: Supply staff participation in workshops and

incorporate modeling into decision making. The Science Program and agencies will develop a protocol for improving the efficiency and use of the PTM.

Progress: In the current round of funding the Authority approved two PSP proposals, one to model the delta smelt population (proposal #106) and one to model salmon in the Central Valley (proposal #214). The executive summaries for the proposals, and all proposals noted below, are available at http://www.science.calwater.ca.gov/psp/psp_package.shtml . In November the Science Program sponsored a Pelagic Organism Decline (POD) workshop which addressed the IEP delta smelt workplan and will sponsor a seminar in December to present the findings from the review. The IEP workplan and supporting documentation used for the workshop are available at http://www.science.calwater.ca.gov/workshop/workshop_pod.shtml. The Delta Smelt Working Group (DSWG) applied PTM more systematically in 2005 and used the results to make recommendations to the EWA agencies on the use of EWA assets to protect larval and post-larval delta smelt. Appendix 1 summarizes the application of the PTM in 2005 including the technical basis for recommendations and a preliminary proposal for improving the use of PTM by EWA biologists.

B. Climate Change Scenarios

Actions: Coordinate with ongoing modeling by DWR and USGS to establish potential future scenarios for water operations, flow, temperature, salinity, and other factors. Actions will require a combination of review, workshops, technical panels, and directed research.

Commitments: CALFED Science Program: Help coordinate efforts to identify implications for project operations and EWA with other agencies. EWA agencies: Staff participation in reviews, workshops, and research, and incorporate outcomes into long-term EWA acquisition and management decision processes.

Progress: The Authority approved funding for CASCaDE: Computational Assessment of Scenarios of Change for the Delta Ecosystem which incorporates various models to predict the effects of climate change on the Delta (proposal #84). In June 2005 USGS and USFWS sponsored a workshop on the Future Challenges Project which addressed global climate change and water resource management.

C. Juvenile Salmonid Mortality Estimates

Actions: Increase monitoring of juvenile fish to develop better estimates of mortality throughout the system. There are additional needs for population models. This will require evaluation of the use, or expanded use, of a variety of monitoring techniques,

potentially including bioaccoustic tracking, Passive Integrated Transponder (PIT) tagging, coded wire tagging, rotary screw trapping, beach seining, and trawling. Establish an expert panel and hold workshops on salmonid monitoring technology to inform a request for directed research proposals. Expansion of salmonid monitoring and research through IEP Plus Project Work Team (CMARP III).

Commitments: CALFED Science Program: Establish an expert panel, coordinate workshops on monitoring techniques, and coordinate a fund request for proposals. EWA Agencies: Supply staff to participate in workshops and evaluate techniques.

Progress: 1). The Authority approved two PSP proposals that address this issue. They include the survival and migratory patterns of juvenile salmonids using bioaccoustic tagging (proposal #313), and a review of four coded-wire tag experiments (proposal #299). 2). The CALFED Science Program held a seminar on PIT tagging, and workshops on Delta Action 8, salmonid monitoring, and predation at the Delta Fish Facilities. Appendix 2 summarizes the purpose of each workshop, their relationship to EWA, and provides links to the background material. 3). In August 2005 DFG completed a general summary of existing Chinook salmon and steelhead monitoring programs. The document is available at http://www.dfg.ca.gov/nafwb/pubs/2005/CV_MonitoringPrograms.pdf and contains program objectives, monitoring methods, variables measured, data management and storage, reporting, staff levels, funding and contact information. 4). In March 2005 NOAA Fisheries published a more comprehensive technical memorandum entitled *Summary of Monitoring Activities for ESA-listed Salmonids in California's Central Valley* which complied data on winter- and spring-run Chinook and steelhead for use in their technical recovery planning. 5). A draft proposal on salmonid monitoring is expected from CMARP III in mid 2006. 6). DWR is funding work on steelhead predation in Clifton Court Forebay using ultrasonic tags (B. Fugimura, DFG-Bay Delta Division, personal communication). 7). DWR funded pilot work using ultransonic tags to assess movement of juvenile salmon in and around Franks Tract (Dave Vogel, personal communication). 8). DWR is also conducting a growth and migratory study of juvenile steelhead on the Feather River using PIT tags (Jason Kindopp, personal communication). Results from these studies may provide beneficial information for EWA biologists on salmonid life-history strategies. 9). Three new Chinook salmon and steelhead monitoring programs have been funded by the CALFED Ecosystem Restoration Program with implementation expected in early 2006. These programs include a Central Valley Constant Fraction Marking program for fall run salmon, Central Valley Chinook Escapement and Steelhead Monitoring Plans, and

the Central Valley Chinook Salmon Age Determination Program. Appendix 3 contains a brief summary of each program.

D. Peer Review of Models

Actions: Peer review of all models, decision trees, gaming etc. Modeling should be scoped and constructed to answer specific questions and incorporate and describe uncertainty. Seek advice or assistance from the California Water and Environmental Modeling Forum or funding post doctorates are possible options.

Commitments: CALFED Science Program: Facilitate peer review of models. EWA agencies: Supply staff to participate in review process and incorporate outcomes into management decision making.

Progress: The Science Program sponsored a science review of the San Joaquin River CALSIM II model. Supporting documents from this review are available at http://www.science.calwater.ca.gov/workshop/calsim_docs_05.shtml. Several models have also been approved for funding through the PSP process. We will follow their progress and participate in the reviews once the models are complete. The CWEMF and CALFED Science Program cosponsored a workshop to review other San Joaquin Valley Modeling in November 2005 which included a salmon population model developed by Dean Marston (DFG). Supporting documents from this workshop are available at http://www.cwemf.org/workshops/SJRModelingWrkshpAgenda.pdf.

E. New Research

Actions: Expand directed research on biological questions related to EWA and increase collaboration between agency scientists and academic scientists to work on these questions. EWA agencies will work collaboratively with the Science Program and its grantees in the development of a body of work that further supports the technical basis for resource decisions. The IEP POD PWT will continue investigating reasons for the decline of pelagic organisms in the estuary, including a possible linkage to increased Delta exports.

Commitments: The CALFED Science Program will fund approximately $6-$10 million of new research starting in 2006. Much of that work is related to the water operations and fish populations as approved at the August 2005 Authority meeting. EWA Agencies: Supply staff to participate in the POD PWT.

Progress: The Authority approved 13 PSP proposals for approximately $10.7 million and the contracts are being developed. A full list of these proposals is available at http://science.calwater.ca.gov/pdf/psp/PSP-Final_Selection_Panel_Results-public_070105.pdf. Information from all 13 proposals will help improve our understanding of the

estuary and its watershed and thus improve the science underlying EWA management. Three proposals, that were not mentioned above, but could provide substantial information include foodweb support in the estuary (#107), life history variation in Steelhead (#140), and the identification of geochemical markers to determine Delta use by Chinook salmon (#179). Finally, in September 2005 the delta smelt white paper, *Critical assessment of the delta smelt population in the San Francisco Estuary*, was published in the San Francisco Estuary and Watershed Science on-line journal. The paper outlines the critical data gaps which need to be addressed in order to develop the necessary tools for management and restoration. The paper is available at http://repositories.cdlib.org/jmie/sfews/vol13/iss2/art1/.

III. Improving the Review Process

A. Include Broader Audience and Better Dialog with the Panel

Actions: The Science Program will establish a new review Panel and request assistance from the new Panel members in the development of the agenda/charge/organization of the review. Continue posting meeting notices, meeting summaries, and technical material on the CALFED website in a timely manner. Provide more opportunity for non-agency scientists to present data/models/interpretations to the Panel and to be included in the primary record of the review process. More interaction is needed among the Panel, Lead Scientist, Science Program, and EWA agencies' staff during development of the review.

Commitments: CALFED Science Program: Facilitate communication among the Panel, CALFED Science Program, and EWA agencies. EWA agencies: Increase level of staff participation and communication with Science Program and Panel.

Progress: The new Panel has not been assembled to date but the Science Program and EWA agencies plan to work with the new Panel, once formed, in preparation for the 2006 EWA Review.

B. Formalize the Response to the Panel

Actions: The CALFED Science Program will formalize the response and make it a permanent part of the review process. The Science Program will foster a joint response by the Lead Scientist and EWA agencies. The response will provide information regarding the capacity of EWA agencies and Science Program to respond to the Panel's review, clarify any information the Panel may have misunderstood, and identify topics on which EWA agencies/Science Program and the Panel disagree.

Commitments: CALFED Science Program: Dedicate staff. EWA agencies: Dedicate staff; provide presentations to the Panel and Authority, including response to the Panel recommendations.

Progress: In 2004 the Lead Scientist and EWA agencies prepared a joint response to the Panel's review and will continue to do so in future years.

C. Revised Review Process

Actions: Change the review period from annual to biennial to allow more progress on key science issues between reviews and better preparation for the review. Use a smaller Panel and incorporate stakeholders into the biennial review process. Change balance of expertise among Panel members to include more biological/ecological and engineering scientists and fewer social scientists. In the off years, certain Panel members may be invited to participate in EWA-related workshops and become more involved in other EWA activities to keep them informed of key issues and results.

Commitments: CALFED Science Program: Facilitate incorporating broader EWA issue, focus key science issues, fund workshops and Panel members to participate in EWA activities or workshops. EWA agencies: Participate in reviews and develop substantive material for review.

Progress: The Science Program changed the review period to biennial starting in 2005. A new Panel is being considered. This year is the first off-year and the workshop will include several Panel members and non-agency scientists. In 2005 one Panel member also participated in the Science Program Predation workshop. The EWA agencies have been preparing substantive material, especially on delta smelt, for the 2006 review.

D. Role of Science Advisors

Actions: Clarify the role of the Science Advisors and their interaction with Panel and the EWA agencies. This will require a change in the charge to the Science Advisors and possible a change in Advisors that will be developed by the Lead Scientist to address important unknowns in the science related to EWA management.

Commitments: CALFED Science Program: Provide staff and clarify role of Science Advisors. EWA agencies: Provide staff and input into the role of Science Advisors.

Progress: In February 2005 the Science Advisors prepared a draft charge for consideration by the Lead Scientist. Appendix 4 summarizes the charge and addresses the Science Advisors primary role, activities, and responsibilities.

Appendix 1

Application of Particle Tracking Modeling to Environmental Water Account Decision-Making

Victoria Poage
California-Nevada Operations Office, U.S. Fish and Wildlife Service, Sacramento, California

Introduction

In its 2004 written review comments, the Environmental Water Account (EWA) Technical Review Panel recommended that Particle Tracking Modeling (PTM) be applied to EWA decision-making. Although PTM has been used sporadically in the past, the Delta Smelt Working Group applied PTM more systematically during water year 2005 than in previous years to assist with the formulation of recommendations intended to protect larval and post-larval delta smelt in the south Delta from entrainment at the State and Federal water export facilities. This paper will provide a summary of the application of PTM in water year 2005, the technical basis for recommendations that were made, and a preliminary proposal for improving the use of PTM for EWA decision-making.

Particle Tracking Model

The California Department of Water Resources' particle tracking model simulates the fate of particles moving through Suisun Marsh and the Sacramento/San Joaquin River Delta (Culberson et al., 2004). The model uses velocity, depth and flow output from the one-dimensional hydrodynamic Delta Simulation Model-2 (DSM2) to determine the location of a particle at a given time-step, based upon specified hydrodynamic input variables. The model uses four types of particle movement (transverse velocity, vertical velocity, transverse mixing and vertical mixing) to represent the particles' ability to move through the water. When a particle approaches a junction, a directional choice is made by allocating probabilities to each channel in proportion to flow. The model can track particle movement from any location within the network and at varied velocities, and can be used to simulate settling or swimming. Mortality can be modeled as losses to water diversions or can be assigned as a rate, which can be a function of age or location in the Delta (CDWR, undated).

Applications

Initial PTM runs. Recent work with PTM in Suisun Marsh indicates that entrainment risk for a particle is strongly influenced by its location relative to a diversion facility (Culberson et al., 2004). In the Delta, the region of consistently high particle entrainment risk includes the San Joaquin River from Vernalis to about Prisoner's Point and all channels connecting this river reach to Old and Middle Rivers (Kimmerer and Nobriga, unpublished data presented at the 2005 IEP Workshop). The Delta Smelt Working Group

(DSWG) used PTM in WY 2005 in conjunction with the Delta Smelt Risk Assessment Matrix (DSRAM; USFWS, 2005) to assist in the formulation of recommendations for modifications of water project operations. Early indicators, such as Spring Kodiak Trawl data and water temperatures, led the DSWG to conclude that most delta smelt spawning would be completed by April 1. Because relatively short spawning periods result in the production of fewer cohorts, larval entrainment losses may impact year-class success in years of short spawning period duration (Bennett, 2005). The DSWG believed that a modification of project operations prior to the beginning of the VAMP period could provide protection to newly-hatched larvae, and so requested in mid-March that California Department of Water Resources (CDWR) hydrodynamic modeling staff run a series of paired PTM comparisons using injection points based upon Spring Kodiak Trawl data. The DSWG specified (in advance of the simulations) a 30% difference in particle fate as the threshold of significance (Table 1). Review of the initial PTM results did not lead to a recommendation from the DSWG, as the 30% difference-in-fate significance criterion was not met.

Table 1. Summary of the five paired PTM comparisons requested by the Delta Smelt Working Group on March 10, 2005.

Pre-VAMP Apr. 1-14	VAMP Apr. 15-May 15	Post-VAMP May 16-31
Baseline vs. Vamp level of exports; particle release points in Cache Slough and Rio Vista	HORB in vs. HORB out; particle release points at Turner Cut and Franks Tract	Baseline vs. Vamp level of exports; particle release points at Turner Cut and Franks Tract
	Current CCF gate ops vs. 24-hour CCF gates open	HORB in vs. HORB out
Decision points:		
-if <10% difference in proportion of particles in Central Delta, then concern is low -if >30% difference, then concern is high	recommend not installing the HORB if there is a >30% difference in particle entrainment	if the HORB is in, recommend removal on May 15 if there is a >30% difference in particle entrainment

Updated PTM runs. By the end of March, the beginning of the VAMP period had been delayed until May 1, in the hope that high flows on the San Joaquin River (SJR) tributaries would have stabilized by that time. To incorporate the latest information from the Spring Kodiak Trawl on delta smelt distribution and projected SJR flows, the DSWG requested additional PTM runs with injection points added in the Central Delta, using the projected VAMP hydrology. The six PTM scenarios run by CDWR staff included:

- San Joaquin River at 7000 cfs with
    - Baseline (full exports)
    - 3000 cfs combined exports beginning 4/16
    - 1500 cfs combined exports beginning 4/16
- San Joaquin River at 10,000 cfs with
    - Baseline (full exports)
    - 5000 cfs combined exports beginning 4/16
    - Baseline exports until 4/30 and 5000 cfs combined exports beginning 5/1

Once again, the DSWG used a 30% difference in particle fate as the threshold of significance. Review of the PTM results (Table 2, Figure 1, a through f) revealed that most of the expected entrainment of particles at the State and Federal export facilities under baseline conditions would occur during the April 16-April 30 period. Particle entrainment from central Delta injection points dropped from >30% to zero at a 5000 cfs level of exports and 10,000 cfs SJR at Vernalis flow and also at a 3000 cfs level of exports and 7000 cfs Vernalis flow. In each case, entrainment was reduced when the combined level of exports was approximately 50% of SJR flow. Because of the high level of concern for delta smelt, the DSWG recommended a reduction in combined exports to 50% of the San Joaquin River flow at Vernalis, to begin as soon as possible and continue until the beginning of the VAMP experiment. This modification of project operations was intended to minimize entrainment of delta smelt larvae and reduce any indirect effects of export pumping on delta smelt prior to the beginning of the VAMP period. The Water Operations Management Team (WOMT) implemented the DSWG's recommendation beginning on April 17. No incidental take was recorded at the export facilities until May 17.

Table 2. Summary of PTM scenarios considered in mid-April by the Delta Smelt Working Group.

Export Level	SJR = 7,000	SJR = 10,000
	Percent of particles entrained by the Projects	
Baseline	> 30%	> 30%
1500 cfs combined	0	
3000 cfs combined	0	
5000 cfs on April 16		0
5000 cfs on May 1		> 30%

Improving Efficiency

Overall efficiency of the application of PTM to EWA decision-making was fairly good in water year 2005. Requests for runs that were made on March 10 and March 28 were fulfilled on March 28 and April 6, respectively, with additional materials made available on April 13. In both cases, turn-around was sufficient to enable timely consideration and formulation of recommendations. However, in their review of the WY 2004 EWA, the EWA Technical Panel remarked on the failure of the EWA implementing agencies to

fully utilize existing models in their decision-making process, specifically mentioning the Particle Tracking Model. The DSWG used real-time survey results to provide some of the injection points for the PTM runs requested in WY 2005, but did not, as suggested, use PTM to evaluate sampling locations. This could be a useful exercise that adds valuable context to survey results; however, it seems unlikely that such an evaluation could be done utilizing existing staff expertise. In the future it may be possible to further develop staff capacity to perform PTM, or it may be appropriate to address this need through future CBDA proposal solicitation processes.

Acknowledgements

The author gratefully acknowledges the critical contributions of Matt Nobriga.

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Culberson, S.D., C.B. Harrison, C. Enright and M.L. Nobriga. 2004. Sensitivity of larval fish transport to location, timing, and behavior using a particle tracking model in Suisun Marsh, California. Amer. Fish. Soc. Symposium 39:257-267

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http://www.fws.gov/sacramento/es/delta_smelt.htm

U. S. Fish and Wildlife Service (USFWS). 2005. Reinitiation of formal and early section 7 endangered species consultation on the coordinated operations of the Central Valley Project and State Water Project and the operational criteria and plan to address potential critical habitat issues. Sacramento, California. 237 pp

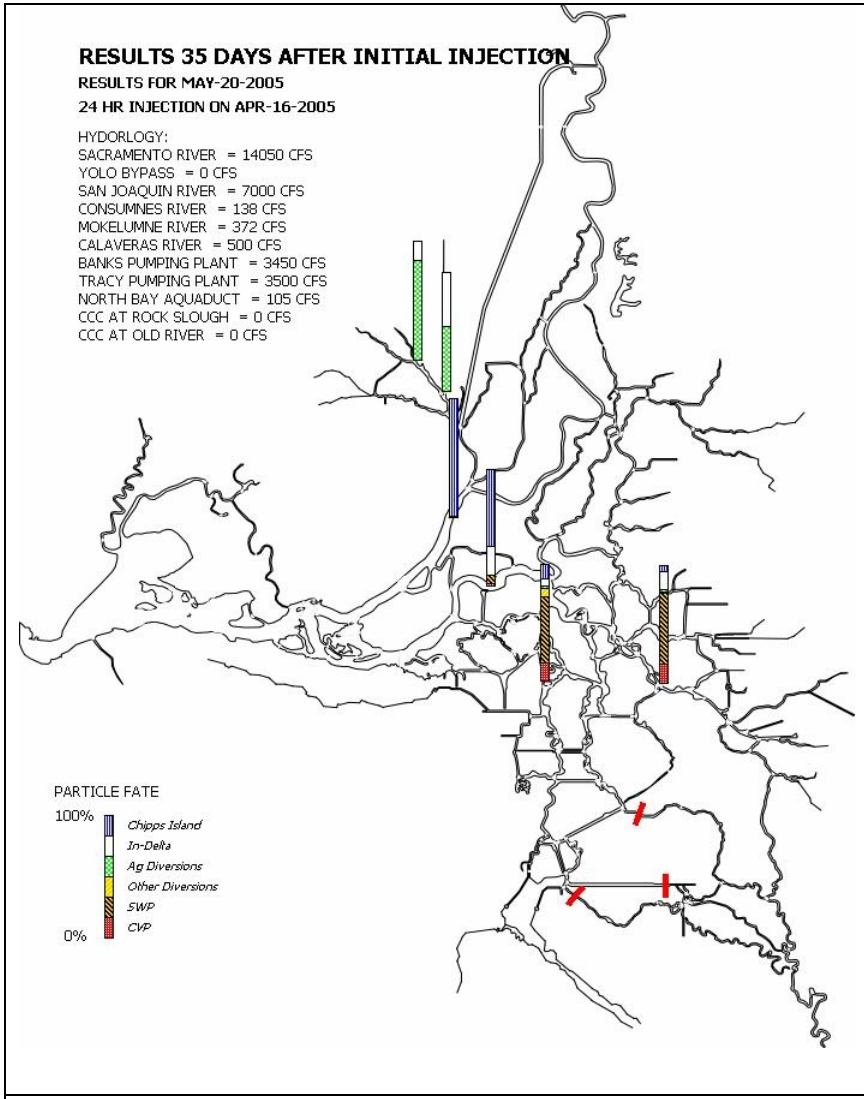


Figure 1.a. Example of PTM output used by the DSWG.

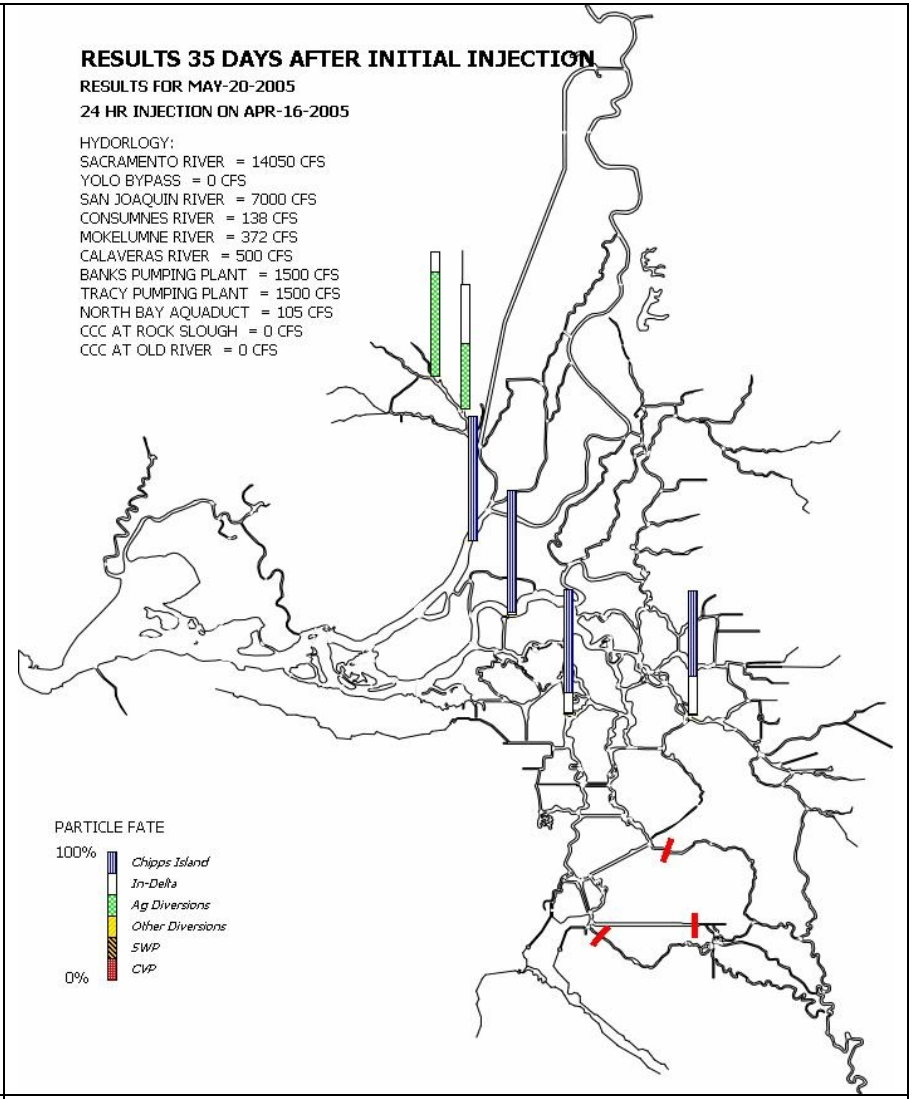


Figure 1.b.

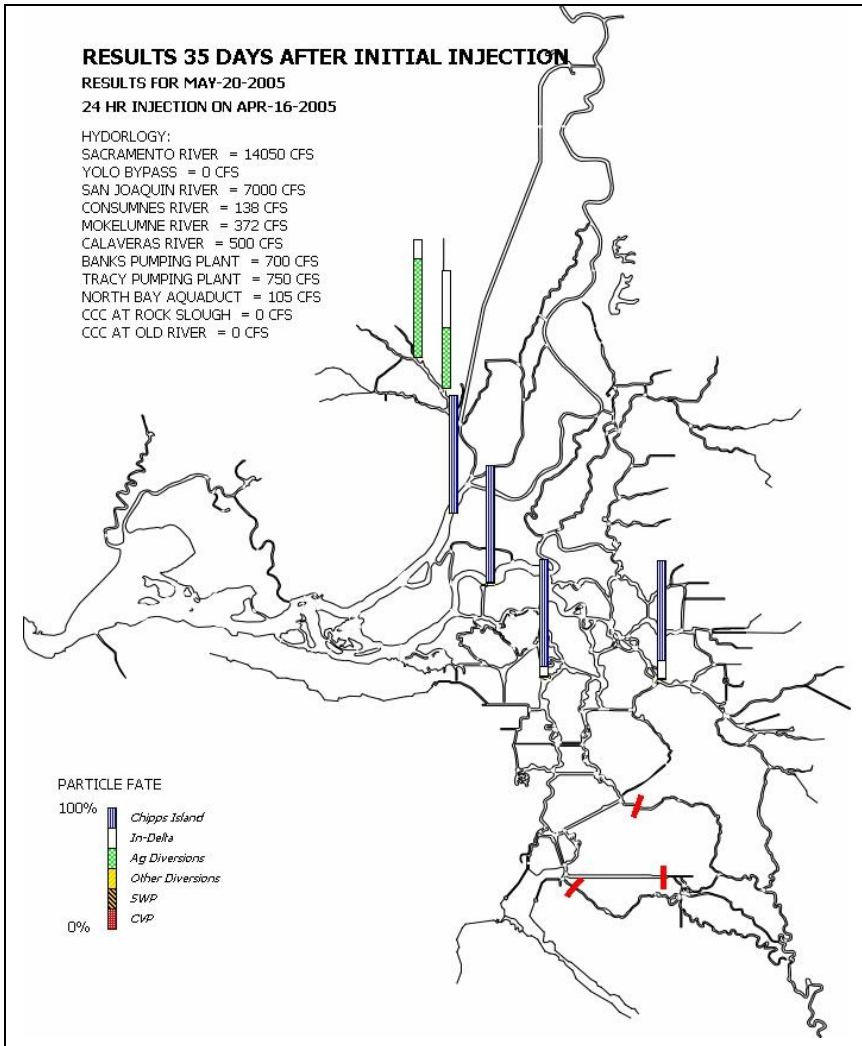
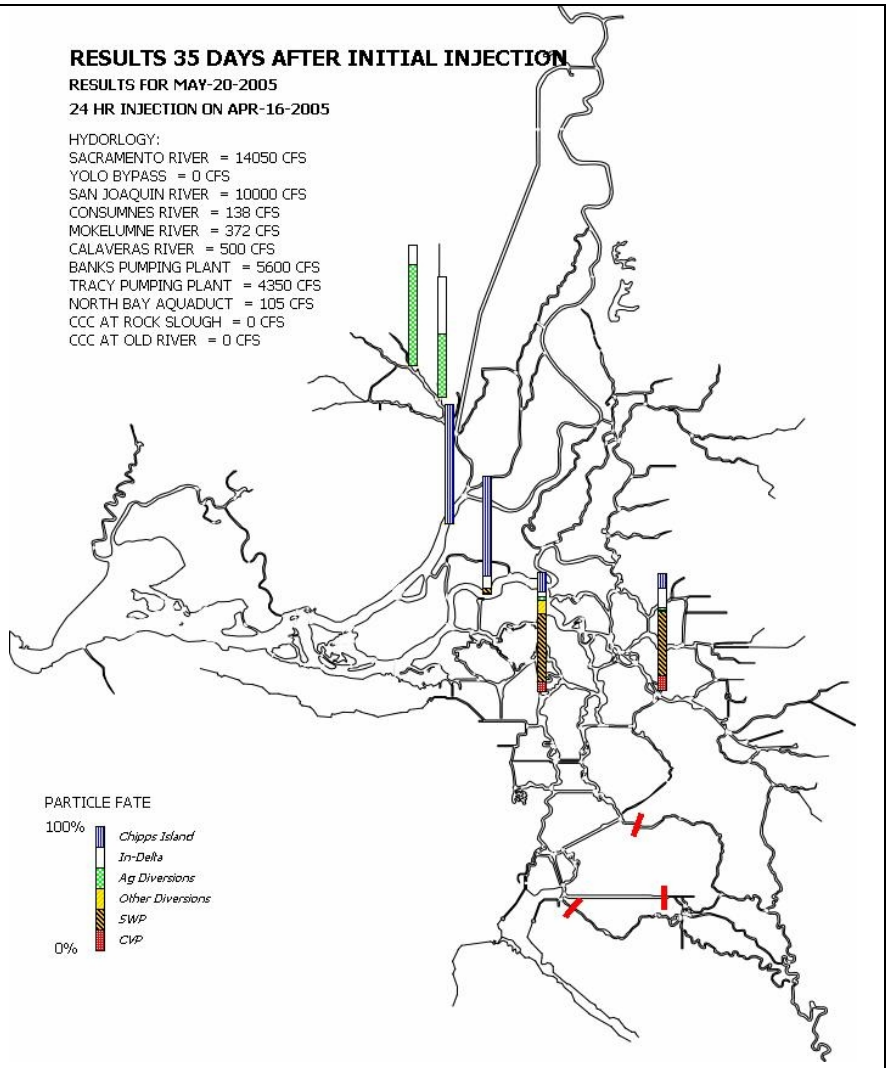


Figure 1.c.



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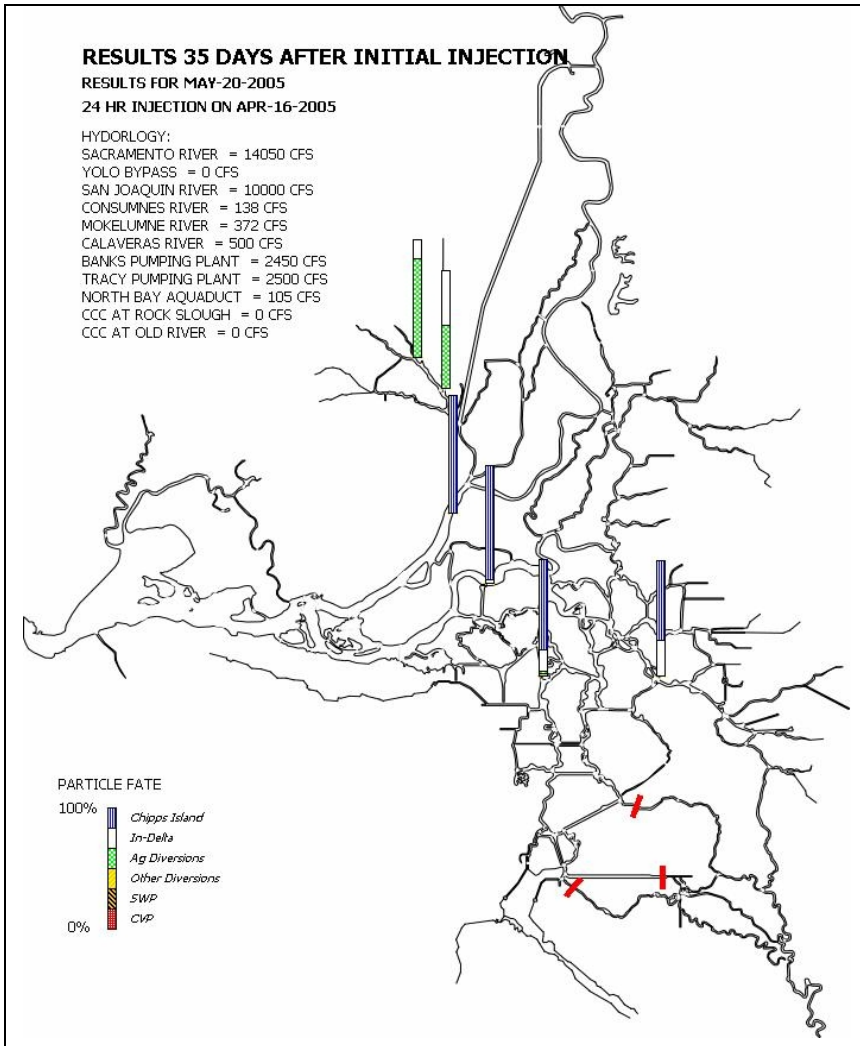

Figure 1.e.

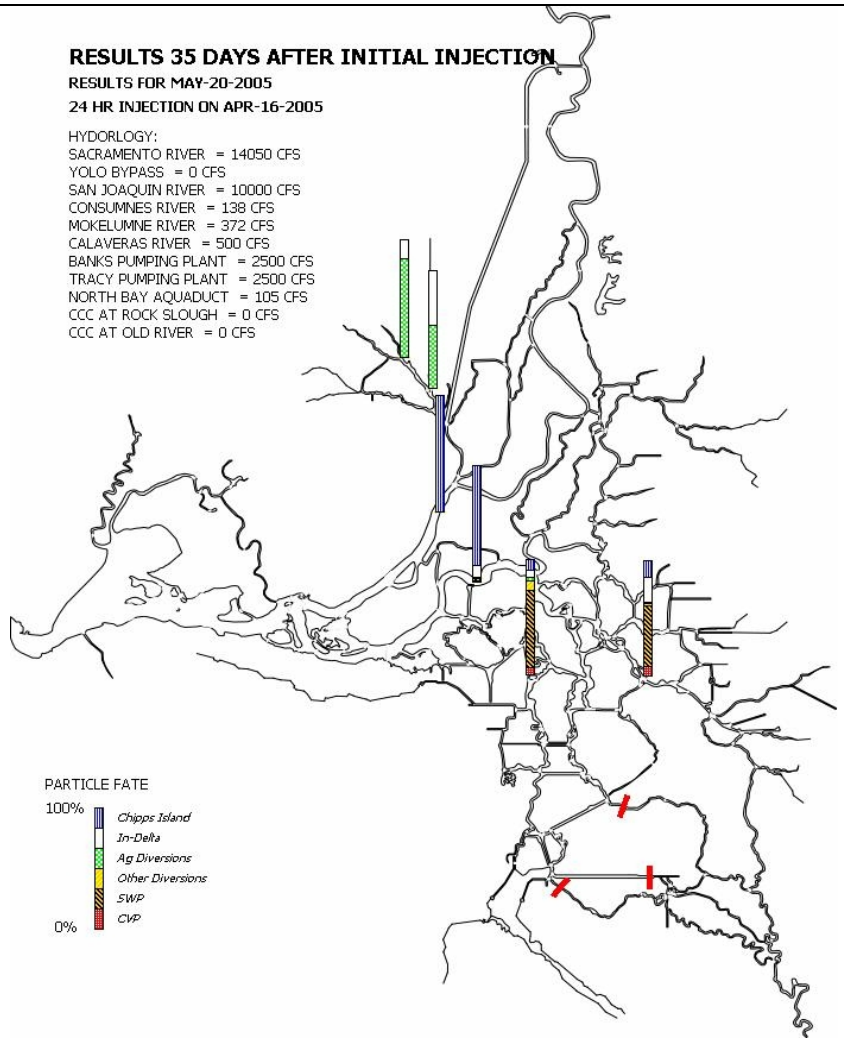

Figure 1.f.

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Appendix 2

EWA related workshops and seminars sponsored by Calfed Science Program in 2005
By RL Brown
11/10/05

In 2005 the Science Program sponsored three workshops that bear on the science underlying the EWA. In conjunction with the UCD Center for Aquatic Biology and Aquaculture, the Science Program also initiated a quarterly seminar series. Two of these seminars provide information of interest to agency and stakeholder biologists and Calfed working on the EWA. The following is a brief summary of these activities.

Workshops

Delta Action 8 workshop

Date – May 27, 2005

Purpose and relation to EWA – The DA 8 studies are to evaluate the effects of water project operation on survival of juvenile Sacramento Valley origin Chinook salmon migrating through the Delta. The workshop objective was to provide information relating to the need and design of 2006 and future DA 8 studies.

Product and status – The Science Advisors prepared an interpretive summary report of the report which is to be posted on the Calfed Science Program website by December 1, 2005. The summary contains recommendations and suggestions by two outside experts. The summary also includes a link to a summary presentation and most of the pertinent study findings. Background data used for the workshop is available at http://www.delta.dfg.ca.gov/jfmp/patfiles.asp.

Predation workshop

Dates – June 22 and 23, 2005

Purpose and relation to EWA – This workshop focused on direct losses of juvenile Chinook salmon and steelhead at the intakes to the CVP and SWP with most of the emphasis on the SWP intake at the Clifton Court Forebay. Delta smelt losses were also considered. The losses to predators play a large role in calculating direct losses of juvenile salmonids. The losses in Clifton Court Forebay are based on the results of previous mark-recapture studies. Losses at the CVP intake are not based on actual studies at the intake. Until this workshop we had no field information on juvenile steelhead behavior in the Forebay.

Product and status – The background material – most of the reports dealing with Forebay losses – was assembled and posted on the Science Program website at http://www.science.calwater.ca.gov/workshops/workshop_predation.shtml. The Science Advisors have drafted a workshop summary and are waiting for the report from five

outside experts describing their conclusions. The release date for the summary report and panel reports can not be determined at this time but hopefully by the end of 2005.

Salmonid monitoring workshop

Dates – August 23-25, 2005

Purpose and relation to EWA – This workshop was sponsored by the Calfed Science Program and the USFWS with the objective of addressing Chinook salmon and steelhead monitoring needs in the watershed, the estuary and ocean. The goal was to start a process that will lead to a more coordinated and useful monitoring program. Much of the data collected by the existing program is used in the salmonid decision tree process. The data will also be the basis of evaluating the population benefits of EWA and other protective and restoration actions.

Product and status – The background material posted to the Science Program web site (http://www.calscience.water.ca.gov/workshops/workshop_cvsm.shtml) included two summaries of exiting monitoring efforts – one by NOAA Fisheries dealing specifically with T&E species and the second by DFG providing a more general summary. The Science Program will release and post a written workshop summary which is expected to feed into a comprehensive monitoring plan being developed by the agencies and Calfed. The summary report will be posted to the Science Program website by December 31, 2005.

Seminars

PIT tag seminar – Two USGS biologists came down from the Pacific Northwest to describe their experiences using PIT tags in Columbia River salmon studies. This was in direct response to a suggestion by the former EWA review panel.

POD seminar – This seminar will actually be held on the morning of December 7, 2005 at UCD. Wim and Ted Sommer will be presenting findings from the review of the declines of pelagic organisms in the estuary.

Appendix 3
New Salmon and Steelhead Monitoring Programs

Over the past year, several new Chinook salmon and steelhead monitoring programs have been planned. Funding has been obtained for these programs from the CALFED Ecosystem Restoration Program; program implementation will begin in early 2006. The following summaries describe these programs and their relationship to the EWA:

- **Central Valley Constant Fractional Marking Program –** Currently, only experimental releases of fall-run Chinook salmon from Central Valley hatcheries are externally marked and coded-wire tagged, resulting in lack of a consistent, coordinated means of objectively sampling and identifying the stock origin of adults captured in various ocean and inland fisheries, and those returning to spawning streams and hatcheries. It is therefore not possible now to monitor the success of actions to restore naturally-spawning populations of fall-run Chinook salmon, including EWA actions; monitor the success of meeting recovery goals; evaluate, minimize and account for the hatchery programs' genetic and ecological effects on natural populations; or evaluate fishery exploitation rates, without knowing the relative contribution of hatchery fish to adult populations.

A comprehensive marking/coded-wire tagging program for production releases of fall-run Chinook salmon from Central Valley hatcheries has been under development since 1998. This year, a detailed proposal and budget were developed for the program, and funding was obtained from the CALFED Ecosystem Restoration Program. Automated marking/tagging equipment will be purchased in 2006; production marking/tagging will begin in the spring of 2007.

- **Central Valley Chinook Salmon Escapement and Steelhead Monitoring Plans –** Existing adult Chinook salmon escapement monitoring programs in the Central Valley are currently inadequate to estimate population status and evaluate population trends in a statistically valid manner for several management purposes: providing a sound basis for assessing recovery of listed stocks, monitoring the success of restoration programs, evaluating the contribution of hatchery fish to Central Valley populations, and sustainably managing ocean and inland harvest. Very few monitoring programs collect data on Central Valley steelhead populations.

Over the past year, proposals were developed for long-term monitoring plans to estimate population status and trends in abundance of adult Central Valley Chinook salmon and steelhead in a statistically valid manner. Funding has been obtained from the CALFED Ecosystem Restoration Program; implementation will begin in 2006.

In development of the plans, existing Chinook escapement programs will be reviewed for adequacy of statistical power or bias. Sampling designs will be reviewed and recommendations made for improvement of existing programs. Comprehensive databases and reporting will be developed linking escapement, hatchery production, and

coded-wire tag data. For steelhead, a statistically-valid monitoring strategy will be developed, along with comprehensive databases and reporting systems.

These plans will result in improvements to the Chinook salmon and steelhead monitoring system that will, in turn, lead to improved real-time management of EWA assets for fishery protection.

- **Central Valley Chinook Salmon Age Determination Program –** Currently, the age of salmon returning to spawn in Central Valley streams is not determined on a consistent basis, even for the listed stocks of winter and spring-run Chinook salmon. This lack of aging data precludes accurate reconstruction of the size of each brood year at various points in the life cycle, and thus precludes accurate life cycle modeling needed to evaluate programs such as the EWA. It is not possible to monitor the success of restoration actions in restoring naturally-spawning populations of Chinook salmon, or monitor the success of meeting recovery goals, without determining the age structure of returning adults and the relative contribution of hatchery fish to adult populations. When age data are available, cohort reconstructions of each brood can provide population parameters such as total ocean abundance, ocean harvest rates, maturation rates, stray rates and the relationship between younger ages in-river to predict older ages remaining in the ocean.

Over the past year, a proposal was developed for a comprehensive Central Valley Chinook Salmon Age Determination Program. Funding was obtained from the CALFED Ecosystem Restoration Program; implementation will begin in 2006.

Appendix 4

Charge to Science Advisors (Revised February 2005)

Primary role:
The advisors report directly to CALFED Lead Scientist and provide advice on issues relating to water management and fish protection and restoration in the Central Valley and San Francisco Estuary, with special emphasis on the Environmental Water Account.

Activities and Responsibilities:
Although the activities of the science advisors are expected to vary each year based on changing priorities and events, many of their activities can be categorized as follows:

1. Keep abreast of EWA operations and fish protection actions
The advisors will keep track of current activities of the Data Assessment Team and Water Operations Management Team, specifically with regard to use of EWA assets for fish protection. The advisors will follow these activities through a combination of attending meetings of the EWA Science Team, monitoring DAT calls and meeting summaries as appropriate and attending WOMT meetings as requested by the Lead Scientist. The advisors will inform the Lead Scientist and Science Program Manager of technical issues that may require their attention. As appropriate the advisors may recommend specific actions to be taken by the Lead Scientist.

2. Work with the Lead Scientist, Science Program staff and agency representatives to organize and participate in periodic reviews of the EWA
Annual reviews of the EWA were an integral part of initial four-year EWA experimental implementation and periodic reviews should be part of the interim (years 5-7) and long-term EWA. The advisors will assist the Lead Scientist in establishing review panels, establishing time frames and agendas for the reviews, preparing and submitting written technical materials, making oral presentations, and drafting responses to EWA panel comments and recommendations.

3. Provide technical assistance to the Lead Scientist in identifying and filling key information gaps.
The CALFED Lead Scientist has overall responsibility for CALFED Science, but may require technical assistance for complex issues such as those involved with EWA and with protection of listed fish species. Information gaps may prevent CALFED from obtaining the maximum benefit from its assets, or may not result in the best combination of actions. To assist the Lead Scientist in this capacity, the advisors will identify science issues that should be addressed through new analyses, workshops, symposia, or additional studies. As directed by the Lead Scientist, the advisors will help organize workshops and symposia, conduct additional technical analyses, and prepare papers for technical review and, if appropriate, publication. These efforts will require that the advisors work closely with Science Program staff, agency representatives, stakeholders

and academic scientists. In addition, the advisors will continue to organize (or participate in organization of) annual workshops on important issues related to the effects of water project operations, particularly EWA, on salmon and delta smelt.

4. Provide technical review

As requested by the Lead Scientist, the advisors will review, or solicit reviewers for, technical documents in the fields of water management, fish ecology, and ecosystem processes. Performance measures being developed by the Science Program and others are expected to be included as a topic for review.

5. Annual workplan

By October 1 of each year the advisors will submit a draft plan outlining their proposed activities for the upcoming year. The plan will be shared with the EWA Science working group before becoming final. The Lead Scientist and the advisors recognize that the plan must be flexible, and that events may preclude all activities being completed on schedule. The advisors will provide progress reports, and the plan will be adjusted if necessary.

6. ***Reporting requirements.***

The advisors shall report frequently to the Lead Scientist or his designee. Most of these reports will be sent by email, but face-to-face meetings or conference calls will be held as needed and schedules permit. At least one of the advisors is expected to attend meetings of the informal EWA Science working group. As requested by the Lead Scientist, the advisors may attend meetings of WOMT, the Agency Coordination Team, the Authority, or BDPAC to present technical information related to water operations and fish and their ecosystems.